VOLUME II: CHAPTER 9

PREFERRED AND ALTERNATIVE METHODS FOR ESTIMATING AIR EMISSIONS FROM SECONDARY METAL PROCESSING

June 1998

DISCLAIMER

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DEFINITIONS OF COMMONLY USED TERMS (ITI, 1992)

Alloying refers to the addition of elements to metals for the purpose of altering the properties of the metals. Strength, ductility, toughness, and resistance to corrosion are examples of properties affected by alloying. Alloying elements include nickel, vanadium, tungsten, silicon, zinc, molybdenum, boron, titanium, aluminum, and lead.

Dross is impurities and semisolid flux that accumulates on the surface of molten metal.

Casting is one of the oldest and most common methods of forming. It requires the melting of a solid, heating it to the proper temperature, treating it to produce a desired chemical composition, and then pouring it into a cavity or mold for solidification.

Chemical Reduction refers to the overall process of breaking metallic-oxide bonds to produce pure metal. It is done in a blast furnace which uses a hopper to feed ore mixtures. Metals produced from reduction include iron, aluminum, titanium, magnesium, and zinc.

Ferrous Metals are metal compounds that contain iron.

Fluxes are materials added to the scrap metal, usually during the melting process, to aid in the purification of the metal.

Forming is the process of shaping molten metal into a solid state. Forming can include the shaping of simple ingots or the casting of precision parts, such as engine blocks. (See casting.)

Nonferrous Metals are metal compounds that do not contain iron.

Smelting is a process used to produce nonferrous metals. In the case of copper, crushed sulfides and oxides are melted in a reverberatory or electrical furnace. During the melt, lighter impurities, known as slag copper, float to the top. Pure copper, iron, and sulfur sink to the bottom to form a product known as matte. Matte may then be oxidized to obtain pure copper.

Oxidation decreases the amount of carbon, silicon, manganese, phosphorous, and sulfur in a mixture of molten pig iron and scrap to form steel. Specific oxidation processes used to make steel include Bessemer, open-hearth, basic-oxygen, and electric furnace.

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INTRODUCTION

This chapter of EIIP Volume II, Point Sources describes emission estimation methods for the secondary metal processing industry. These methods are ranked according to accuracy of the resulting estimate. These chapters serve two primary purposes. First, they are designed to be used as a reference for estimation methods, and second, through the use of a standard set of methods, the quality of emission inventories can be expected to improve. Much of the information is based on the *AWMA Air Pollution Engineering Manual* and EPA's emission factor document, *AP-42* 5th edition (AWMA, 1992; U.S. EPA, 1995). Other information was collected from consultants to the industry and state agencies.

Section 2 of this chapter describes the primary types of operations in use at secondary metal processing facilities, the emission sources and emission controls techniques. Secondary operations, such as boilers and wastewater collection and treatment, are discussed in Chapters 2 and 5, respectively, of this volume. Section 3 provides an overview of available estimation methods: stack sampling, emission factors, continuous emissions monitoring systems, and material balance. A comparison of the methods is presented.

Section 4 presents the preferred methods which differ depending on the process and pollutant for which an estimate is to be made. Section 5 presents the alternative methods. Quality assurance and quality control procedures are discussed in Section 6. More detailed information is provided in Chapter 1 of this volume and in the EIIP QA document, Volume VI. In Section 7, Data Coding Procedures, a list of Source Classification Codes (SCCs) and Aerometric Information Retrieval System (AIRS) control codes are provided to encourage the widespread use of these two systems so that inventory data can be shared more easily. References are provided in Section 8.

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GENERAL SOURCE CATEGORY DESCRIPTION

This section provides a brief overview of secondary metal processing. The reader is referred to the *Air Pollution Engineering Manual* (referred to as *AP-40*) and *AP-42* 5th edition, for a more detailed description of the processes (AWMA, 1992; U.S. EPA, 1995).

2.1 PROCESS DESCRIPTIONS

Secondary metal processing may be described as the processing of metal-containing materials to recover the metal. The specifics of the recovery process vary depending on the type of metal being processed, especially between ferrous and non-ferrous industries. Processes may even vary among facilities processing the same type of metal. However, the processes used by the different industries to recover metals may be grouped or classified by one of the following five general processes:

- Raw materials handling;

- Scrap pretreatment;

- Metals melting;

- Metal Refining; and,

- Metal forming.

These processes are described in the following paragraphs and in Figure 2.1-1. The information is not intended to be used as descriptions of specific industries, but is intended to provide the reader information on what types of operations and processes may result in emissions, regardless of the type of metal being processed. It should be noted that not all metal processing industries, or facilities, use all of the five general processes; they may use only some of them.

2.1.1 RAW MATERIALS HANDLING

Material handling operations include receiving, unloading, storing, and conveying the metal-containing materials and the materials required for metal processing such as fluxes, alloys, fuels, and casting materials. The types of materials used may vary depending on the metal being processed. At iron foundries, for example, metallic raw materials might include

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┌─────────────────────────────────────┐
│  Raw Materials Handling              │
├─────────────────────────────────────┤
│  Receiving                           │
│  Storage                             │
│  Transfer/conveying                  │
└─────────────────────────────────────┘
                    ↓
┌─────────────────────────────────────┐
│  Scrap Pretreatment                  │
├─────────────────────────────────────┤
│  Mechanical separation               │
│  Solvent cleaning                    │
│  Centrifugation                      │
│  Pyrometallurgical cleaning          │
│  Hydrometallurgical cleaning         │
└─────────────────────────────────────┘
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┌─────────────────────────────────────┐
│  Metal Melting                       │
├─────────────────────────────────────┤
│  Furnace charging                    │
│  Melting                             │
│  Reduction                           │
│  Oxidation                           │
└─────────────────────────────────────┘
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┌─────────────────────────────────────┐
│  Metal Refining                      │
├─────────────────────────────────────┤
│  Furnace charging                    │
│  Alloying                            │
│  Refining                            │
└─────────────────────────────────────┘
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┌─────────────────────────────────────┐
│  Metal Forming and Finishing         │
├─────────────────────────────────────┤
│  Pouring                             │
│  Casting                             │
│  Finishing                           │
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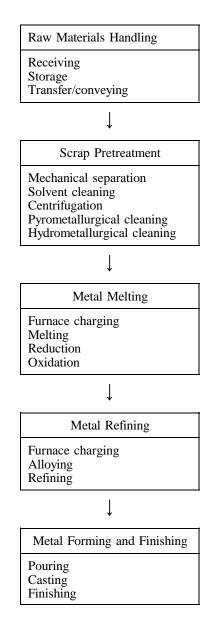
FIGURE 2.1-1 FLOW DIAGRAM OF SECONDARY METAL PROCESSING OPERATIONS*

* It should be noted that not all industries, or facilities, use all of the processes and operations. They may use only some of them.

pig iron, iron and steel scrap, foundry returns, and metal turnings. Fluxes used at iron foundries might include carbonates (limestones, dolomite), fluoride (fluorospar), and carbide compounds (calcium carbide). Examples of alloys used in secondary aluminum processing include zinc, copper, manganese, magnesium, and silicon. The fuels used in secondary metal processing might include coal, oil, natural gas, or coke. Coal, oil, or natural gas are used to fire furnaces; coke is used as fuel for cupolas at iron foundries. Raw materials used in mold and core making for casts include sand and additives.

2.1.2 SCRAP PRETREATMENT

Scrap refers to discarded materials, such as old appliances and automobile parts that contain a metal of interest, as well as to metal-bearing by-products or wastes generated by other operations in secondary metal processing. The scrap pretreatment process prepares the scrap for melting and involves sorting and processing metal-containing scrap to separate the metal of interest from unwanted materials and contaminants such as dirt, oil, plastics, and paint. Scrap pretreatment also involves the preliminary separation of the metal of interest from other metals contained in the scrap. The most commonly used operations, one or more of which are used by all secondary metal processing facilities, are described below.

Mechanical Separation

Mechanical separation usually begins with sorting, crushing, pulverizing, shredding, and other mechanical means to break scrap into small pieces. Breaking the scrap into smaller pieces improves the efficiency of removing unwanted materials and concentrating the metal for further processing. Methods used to concentrate the metal include magnetic removal, eddy currents, screening, and pneumatic classification. Secondary copper processing and secondary aluminum processing are two of the secondary metal processing industries that make use of mechanical separation operations.

Solvent Cleaning

Solvent cleaning of scrap is performed to remove grease and oils. This method is used at some facilities that utilize electric furnaces to melt metal.

Centrifugation

Centrifugation is another cleaning process for removing grease and oils from the scrap although it is rarely used. Like solvent cleaning, this operation is found at some facilities that use electric furnaces.

Pyrometallurgical Cleaning

Pyrometallurgical cleaning techniques use heat to separate the metal of interest from contaminates and other metals. Pyrometallurgical techniques include roasting and sweating. The roasting process involves heating metal scrap that contains organic contaminates to temperatures high enough to vaporize or carbonize the organic contaminates, but not high

enough to melt the metal of interest. Burning insulation from copper wire is an example of a roasting process. In the aluminum industry, roasting is used to vaporize water.

The sweating process involves heating scrap containing the metal of interest and other metals to temperatures above the melting temperature of the metal of interest but below that of the other metals. For example, sweating recovers aluminum from high-iron-content scrap by heating the scrap to temperatures above the melting temperature of aluminum, but below the melting temperature of iron. This condition causes aluminum and other constituents with low melting points to melt and trickle down the sloped hearth, through a grate and into air-cooled molds or collecting pots. The materials with higher melting points, including iron, brass, and the oxidation products formed during the sweating process, are periodically removed from the furnace.

It should be noted that while pyrometallurgical cleaning is not used at iron and steel foundries, at some foundries the metal is preheated to facilitate melting and conserve energy.

Hydrometallurgical Cleaning

Hydrometallurgical cleaning techniques include leaching and heavy media separation. First, the scrap is crushed and then washed with water to remove water-soluble contaminants. The remaining material may be screened or magnetically separated before it goes to the melting process. Leaching is used in secondary copper and secondary zinc processing.

Heavy Media Separation

The heavy media separation process separates high density metal from low density metal using a viscous medium. Metal-containing materials are added to water. Compressed air is applied and chemicals are added that cause the low density metal to float to the surface of the liquid medium and form a foam of air bubbles. The foam is subsequently removed. Secondary aluminum processing and secondary copper processing use heavy media separation to separate metals.

2.1.3 METAL MELTING

Melting is performed primarily to separate the metals of interest from their metallic compounds, although impurities and contaminants remaining after the pretreatment operation may also be removed. The melting operation, referred to as smelting in nonferrous metal processing, takes place in furnaces or heated crucibles. The furnaces may be heated with fuels or through the use of electricity.

Pretreated scrap, fuels, and flux materials are added ("charged") to the furnace where melting takes place. The mixture of the flux materials depends on the type of metal being processed. In secondary lead processing, for example, flux materials may consist of rerun slag, scrap iron, coke, recycled dross, flue dust, and limestone. The flux may chemically react with the scrap in the presence of heat, breaking metallic-oxide bonds to produce pure metal. The

process is called chemical reduction. Also, the flux may oxidize impurities in the scrap and further purify the metal.

The metal melting operation is sometimes performed in a series of furnaces. For example, copper scrap is melted in a blast furnace resulting in slag and impure copper. The impure copper is then charged to a reverberatory furnace, where copper of higher purity is produced.

2.1.4 METAL REFINING

The refining operations further purify the metal and produce the desired properties of the metal. Refining may take place in the melting furnace, or it may be performed in holding furnaces or other heated vessels separate from the melting furnace. These furnaces may be heated with fuels or with electricity. Materials are added to the molten metal in the furnace to remove impurities. For example, in copper processing, air is introduced to oxidize any contaminants. Chlorine or fluorides may be added to an aluminum refining furnace to react with magnesium, facilitating its separation from the aluminum.

Alloying is the adding of materials to the refining furnace to produce desired properties of the metal. Strength, resistance to corrosion, and ductility are examples of properties enhanced by alloying. Alloying materials may include nickel, titanium, molybdenum, and silicon.

Another method of refining is distillation. In the distillation process used in the zinc industry, molten zinc is heated in a furnace until the zinc vaporizes. The zinc vapor is condensed and recovered in several forms depending upon temperature, recovery time, absence or presence of oxygen, and equipment used.

2.1.5 METAL FORMING AND FINISHING

After refining, the metal may be formed to make bars and ingots, or it may be formed to make a final product. At iron and steel foundries, this process is normally referred to as "metal coating" or "coating." Bars and ingots, such as those produced in the secondary lead and aluminum industries, may be sent to another facility to make a final product. In some industries, such as at iron and steel foundries, the metal is cast into a final product at the melting facility.

Forming the metal into a final product requires the use of molds and cores. Molds are forms used to shape the exterior of castings. Cores are shapes used to make internal voids in castings. In the iron industry, molds are prepared from wet sand, clay, and organic additives, and are usually dried with hot air. Cores are made by mixing sand with organic binders or organic polymers and molding the sand into a core. Some cores are baked in an oven.

After the metal is formed, it is removed from the mold or container in which it was formed. If the formed metal is a final product, it may be necessary to grind or sand off rough edges. Also, the metal may be shot-blasted to remove mold sand or scale.

2.2   EMISSION SOURCES

Emissions from secondary metal processing occur throughout production, beginning with material handling and storage. Some of the metal processing operations are enclosed and emissions are collected and vented through stacks to reduce employee exposures. Secondary metal processing also produces fugitive emissions, much of which results from raw material storage and handling. The sources for emissions are discussed further below. Section 7 also lists a number of the emission points as Source Classification Codes (SCCs).

Several types of pollutants may be generated during secondary metal processing. Among these are sulfur oxides (SO_x), nitrogen oxides (NO_x), carbon monoxide (CO), carbon dioxide (CO_2), particulate matter (PM), organic compounds, acid gases, chlorides, and fluorides. Sulfur oxides, NO_x, CO, and CO_2 are primarily combustion byproducts; PM emissions occur from many of the operations. The constituents in PM, organic compounds, and acid gases vary according to the type of metal scrap being processed and the processes used. Data that may be used to identify specific hazardous air pollutants (HAPs) emitted as PM, organic compounds, or acid gases are limited. Generally in the case of PM, the constituents are elemental metals or metal oxides. Organic compounds may be contaminants that are being removed, additives used in the process, or byproducts generated during the process. Acid gases may be formed during some processes. It should be noted that not all processes produce all of the pollutants identified above. The pollutants produced are specific to the process and operation.

Although the operations used in metal processing can be similar and have some pollutant emissions in common (for example, NO_x, CO, and PM), there are no data available to indicate that qualitative and quantitative emissions information developed for one type of metal processing can be used to estimate emissions from another type of metal processing. Emission factors, for example, are specific to the industry for which they were developed. There may be occasions, however, where processes and materials are similar enough that it may be reasonable to use emissions information or estimation methods for one to apply to the second.

2.2.1   RAW MATERIAL HANDLING AND STORAGE EMISSIONS

Raw materials include scrap metal, fluxes, alloys, fuels, as well as sand and additives for molds and cores. Emissions are generated from receiving, unloading, storing, conveying, and mixing these materials. Particulate matter emissions are produced during the handling and storage of scrap and fluxes and sand handling and preparation. Organic compound emissions may occur from fuel and solvent storage tanks and from mold and core preparation. Emissions may be collected and released as stack emissions from enclosed processes or as fugitives from open processes.

2.2.2   SCRAP PRETREATMENT EMISSIONS

Particulate matter emissions result from mechanical pretreatment operations such as shredding, crushing, and breaking, as well as during fuel combustion if preheating is used. Organic

compound emissions occur when solvent cleaning or pyrometallurgical cleaning are used. Pyrometallurgical cleaning also may result in emissions of CO, CO_2, and NO_x. Sulfur oxides are emitted when the scrap contains sulfur compounds and from sulfur in the fuel used for heating. Hydrogen chloride gas (HCl) will be generated if roasting is used to burn off insulation that contains chlorinated organics such as polyvinyl chloride. In secondary lead processing, sulfuric acid mist is released from battery breaking and crushing. Pollutants from scrap treatment for which data are available are listed in Table 9.2-1. No data are available for secondary magnesium processing; however, because of the similarity of some of the processes, the types of pollutants emitted are expected to be the same as those emitted from other metal processing, such as PM, CO, and organic compounds. Some facilities enclose scrap pretreatment operations and emissions are collected and vented from a stack. At facilities where these operations are performed in an open area, or where enclosures and ventilation are poorly maintained, fugitive emissions will result.

2.2.3 METAL MELTING EMISSIONS

Emissions from furnaces result from the interaction of the materials in the furnace (scrap metal, fluxes, alloys, etc.) and from the combustion of fuels used to heat the furnace. In the case of electric furnaces, there are no combustion emissions from the furnace and fuel combustion emissions occur only at facilities that generate their own electricity. The highest concentrations of emissions occur when the furnace lids and doors are opened during charging, alloying, and other operations. Furnace emissions are often collected and vented through a stack. Emissions that are not exhausted from the furnace stack are vented through building exhaust vents used to remove heat and create air circulation for the building.

Emissions from charging will consist of organic and inorganic particulate, organic vapors, and CO_2. Emissions from furnace burners depend on the type of fuel used and may contain CO, CO_2, NO_x, and SO_x. Organic compound emissions may also occur as residual oils or greases on the scrap are vaporized, depending on the degree of removal during pretreatment.

Emissions that result from fluxing operations depend on both the type of fluxing agents and the amount of flux required, both of which are a function of scrap quality. Emissions from fluxing generally include various chlorides and fluorides.

Table 9.2-2 presents a list of pollutants emitted from metal melting operations for which data are available. Data are limited for secondary copper and secondary zinc processing. However, because of process similarities, some pollutants found at other types of secondary processing facilities, such as organic compounds and CO, would also be expected to be emitted.

2.2.4 METAL REFINING EMISSIONS

One emission source in metal refining is the fuel combustion used to heat the furnace. Combustion emissions including CO, CO_2, NO_x, SO_x, and PM are generated. When an electric furnace is used, there are no combustion emissions unless the facility produces its own electricity. Particulate matter is also generated when alloys are added to the molten

TABLE 9.2-1

SCRAP PRETREATMENT EMISSIONS AND CONTROL TECHNIQUES [a]

Process	Pollutant	Control Technique	Typical Control Efficiency
Iron Foundries	Particulate matter (metal oxides)	No data	No data
	Organic compounds	Afterburners	95%
	Carbon monoxide	Afterburners	95%
Steel Foundries	Particulate matter (metal oxides)	No data	No data
	Organic compounds	Afterburners	95%
	Carbon monoxide	Afterburners	95%
Secondary Aluminum Processing	Particulate matter (metal oxides)	Fabric filter with and without lime injection	95% - 99%
	Organic compounds	Afterburners	>90%
	Carbon monoxide	No data	No data
	Chlorides; fluorides; HCl	Afterburner; fabric filter with lime injection	>90% for HCl
	Sulfur oxides	No data	No data
Secondary Lead Processing	Particulate matter (metal oxides)	Fabric filter	99%
	Sulfur oxides	No data	No data
	Sulfuric acid mist	Wet scrubbers	

TABLE 9.2-1

(CONTINUED)

Process	Pollutant	Control Technique	Typical Control Efficiency
Secondary Copper Processing	Particulate matter (metal oxides)	Fabric filters	>99%
	Organic compounds	Afterburners	>90%
	HCl	No data	No data
Secondary Zinc Processing	Particulate matter (metal oxides)	No data	No data
	Zinc		

NOTE: No data for secondary magnesium processing were identified.
[a] Reference: U.S. EPA, 1995

TABLE 9.2-2

METAL MELTING EMISSIONS AND CONTROL TECHNIQUES [a]

Process	Pollutant	Control Technique	Typical Control Efficiency
Iron Foundries	Particulate matter (metal oxides)	Scrubbers	45% - 95%
		Fabric filters	98%
	Organic compounds	Afterburners	95%
	Carbon monoxide	Afterburners	95%
	Sulfur dioxide	No data	No data
	Nitrogen Oxides		
	Chlorides; fluorides		
Steel Foundries	Particulate matter (metal oxides)	Fabric filters; scrubbers	No data
	Organic compounds	No data	No data
	Carbon monoxide		
	Sulfur dioxide		
	Chlorides; fluorides		
Secondary Aluminum Processing	Chlorides; fluorides	Venturi scrubbers (fluorides)	No data
	Particulate matter (metal oxides)	Fabric filter with lime injection	85% - 99%
	Organic compounds	No data	No data
	Carbon monoxide		

TABLE 9.2-2

(CONTINUED)

Process	Pollutant	Control Technique	Typical Control Efficiency
Secondary Aluminum Processing (continued)	Nitrogen oxides	No data	No data
	Sulfur oxides		
	Chlorides; fluorides; HCl	Fabric filter with lime injection	>90% for HCl
Secondary Lead Processing	Particulate matter (metal oxides)	Cyclones	No data
		Fabric filters	99%
		Venturi scrubber with demister	99%
	Sulfur oxides	Wet scrubbers	No data
	Organic compounds	No data	
	Carbon monoxide		
	Sulfides; sulfates		
Secondary Magnesium Processing	Particulate matter	No data	No data
	Organic compounds		
	Carbon monoxide		
Secondary Copper Processing	Particulate matter (metal oxides)	Fabric filters	99%
		ESPs	No data
	Lead	No data	No data

TABLE 9.2-2

(CONTINUED)

Process	Pollutant	Control Technique	Typical Control Efficiency
Secondary Zinc Processing	Particulate matter (metal oxides)	Fabric filters	No data
	Zinc	No data	

[a] Reference U.S. EPA, 1995.

metal. These alloys usually consist of various metals and although the amount of pollutants released may not be significant, numerous types of metals and metal compounds may be emitted, depending on the type of metal being processed.

Emissions may result when materials are added to enhance the refining process. For example, in secondary aluminum refining, chlorine or aluminum fluoride may be added to the molten metal to remove magnesium. Chlorides, fluorides, and HCl may be emitted from such operations.

Pollutants emitted from metal refining operations for which data are available are presented in Table 9.2-3. No data are available for zinc processing, although some pollutants such as PM, CO, and organic compounds emitted from other types of metal would be expected to be emitted from zinc processing because of process similarities. Because refining in secondary aluminum and secondary magnesium industries occur in the same furnace as melting, the associated pollutants are shown in Table 9.2-2, Metal Melting Emissions and Control Techniques.

2.2.5 METAL FORMING AND FINISHING EMISSIONS

As the molten metal is poured into molds, PM, CO, and organic compound emissions are generated, with the emissions continuing as the mold cools. Particulate matter emissions are also produced when the form is released from the mold, especially when a shaking or vibrating operation is used. If the form requires finishing, such as grinding or milling, more PM emissions result. Data are available only for iron and steel foundries and secondary lead processing and are shown in Table 9.2-4. Particulate matter, CO, and organic compounds are expected from core baking and organic compounds evaporate during mold drying. Emission types from mold and core production at iron and steel foundries are shown in Table 9.2-5. Emissions from mold and core production at other metal processing facilities are expected to be similar.

2.3 DESIGN AND OPERATING FACTORS INFLUENCING EMISSIONS

Emissions are affected by several factors and to develop an accurate estimate of emissions, as many of these should be taken into account as possible. Two important factors are the process design and how the process is operated. Both may vary significantly from facility to facility; thus no specific guidance on how an emission estimate must be adjusted can be provided. The reader should collect information specific to the facility in order to derive the best emission estimate. A few common factors to consider are listed below.

- Is the facility operating as it was designed? Have process and ventilation systems been modified to accommodate any differences from design conditions?

- Does the facility have emission control equipment or practices in place? How effective are these?

TABLE 9.2-3

METAL REFINING EMISSIONS AND CONTROL TECHNIQUES [a]

Process	Pollutant	Control Technique	Typical Control Efficiency
Iron Foundries	Particulate matter	Fabric filters	
	Organic compounds	No data	No data
	Carbon monoxide	No data	
Steel Foundries	Particulate matter (metal oxides)	No data	No data
Secondary Aluminum Processing	Refining is performed in the melting furnace. See Table 9.2-2		
Secondary Lead Processing	Particulate matter (metal oxides)	No data	No data
	Sulfur Dioxide		
Secondary Magnesium Processing	Refining is performed in the melting furnace. See Table 9.2-2		
Secondary Copper Processing	Particulate matter (metal oxides)	No data	No data
	Sulfuric acid mist		
Secondary Zinc Processing	Particulate matter (metal oxides	Fabric Filters	98-99%

[a] Reference: U.S. EPA, 1995.

TABLE 9.2-4

METAL FORMING EMISSIONS AND CONTROL TECHNIQUES [a]

Process	Pollutant	Control Technique	Typical Control Efficiency
Iron Foundries	Particulate matter (metal oxides)	Fabric filters	No data
Steel Foundries	Particulate matter (metal oxides)	Fabric filters; Venturi scrubbers	98% - 99.9%; 94% - 98%
Secondary Lead Processing	Particulate matter (metal oxides)	No data	No data

NOTE: No data are available for secondary aluminum, magnesium, copper, and zinc processing.

[a] Reference: U.S. EPA, 1995.

TABLE 9.2-5

MOLD AND CORE PRODUCTION EMISSIONS AND CONTROL TECHNIQUES [a]

Process	Pollutant	Control Technique	Typical Control Efficiency
Iron Foundries	Particulate matter (metal oxides)	Scrubbers; fabric filters	No data
	Organic compounds	Afterburners; scrubbers	
	Carbon monoxide	No data	
Steel Foundries	Particulate matter (metal oxides)	Scrubbers; fabric filters	No data
	Organic compounds	Afterburner; scrubbers	
	Carbon monoxide	No data	

NOTE: No data are available for secondary aluminum, lead, magnesium, copper, and zinc processing.

[a] Reference: U.S. EPA, 1995.

- Has the facility optimized its operation to minimize emissions? For example, if scrap is not cleaned adequately, organic contaminants may remain and be volatilized later in the process. Where incineration is used, this will increase combustion byproducts.

- What are the facility's maintenance and housekeeping practices?

- Are systems enclosed or open?

- Are systems automated or manual?

- What kinds of contaminants are introduced in the scrap materials? At what concentrations are these contaminants?

2.4   CONTROL TECHNIQUES

Add-on control devices to reduce emissions are in common use at secondary metal processes. These include scrubbers for condensible PM and acid gases, incinerators for organic compounds; and cyclones, ESPs, and fabric filters for solid PM. These controls should be taken into account when estimating emissions from these processes. For example, if an emission factor representing emissions from an uncontrolled source is used to estimate emissions from a controlled source, the control efficiency of the control device used must be included in the emissions calculations. The available data relating to the types of control devices used in secondary metal processing and their respective control efficiencies are provided in Tables 9.2-1 through 9.2-5. No information was found on NO_x or CO_2 control. Because of process similarities among the metals, some assumptions about the types of controls that may be in use can be made since there are a limited set of control technologies for any given pollutant. The inventory preparer should verify the use of controls to be sure emissions are not underestimated. A brief description of each of the typical control devices is presented below. However, the reader should consult air pollution control references for details of the principles of operation and effectiveness of control of each of the different pollutants, as well as with the facility for the specifics of their process. It should be noted that not all industries use all of the devices listed here.

2.4.1   WET SCRUBBERS

Wet scrubbers are used to reduce solid and condensible PM and acid gases such as HCl and SO_2. Pollutant removal is achieved through the process of absorption; a liquid is selected in which the targeted pollutants are soluble and conditions (e.g., flow rate, temperature, and surface area for contact) are optimized to maximize pollutant removal.

2.4.2   THERMAL AND CATALYTIC INCINERATION

Incineration is an effective method of reducing emissions of organic compounds. Incineration systems used as control devices consist of burners, and a chamber. The burners ignite the

fuel and combustion pollutants; the chamber provides appropriate residence time for the oxidation process.

In thermal incinerators, which are sometimes referred to as afterburners, the combustible waste gases pass over or around a burner flame into a residence chamber where oxidation of the gases is completed. Catalytic incineration is similar to thermal incineration. The main difference is that after passing through the flame area, the gases pass over a catalyst bed which promotes oxidation at a lower temperature than does thermal incineration. Metals in the platinum family and various oxides of copper, chromium, vanadium, nickel, and cobalt are frequently used as catalysts.

2.4.3 CYCLONES

Cyclones provide a low-cost, low-maintenance method of removing relatively larger sizes of PM from gas streams. Particulate matter suspended in the gas stream enters the cyclone and is forced into a vortex by the circular shape of the cyclone. As the gas spirals in the cylindrical section of the cyclone, the PM moves outward to the cyclone wall due to the centrifugal force and is caught in the thin layer of air next to the wall. The PM is carried downward by gravity to be collected in the hopper at the cyclone base.

2.4.4 ELECTROSTATIC PRECIPITATORS (ESPS)

An ESP is a PM control device that uses electrical forces to move the particles out of the flowing gas stream and onto collector plates. The particles are given an electric charge by forcing them to pass through a corona, a region in which gaseous ions flow. The charged particles are forced to the walls of the ESP by an electrical field coming from electrodes positioned in the center of the gas flow. When the particles come close enough to the wall, they are collected on plates. Once the particles are collected on the plates, they must be removed from the plates without reentering them into the gas stream. This is usually accomplished by knocking them loose from the plates, allowing the collected layer of particles to slide down into a hopper, from which they are removed.

2.4.5 FABRIC FILTERS

Fabric filter systems, sometimes called baghouses, remove PM from a gas stream by passing the stream through a porous fabric. The particles form a porous layer of dust on the surface of the fabric which acts as a filter and causes additional PM removal. Also, fabric filter systems are available with pre-coated bags. The coating improves air flow and collection efficiency and protects the fabric from harsh start up environments. The two most common baghouse designs are the reverse-air and the pulse-jet types. These names describe the cleaning system used with the design.

Reverse-air baghouses operate by directing the dirty flue gas into the middle of the bags. Collection of dust is on the inside surface of the bags. The bags are cleaned periodically by reversing the flow of air, causing the previously collected dust cake to fall from the bags into a hopper below.

Pulse-jet baghouses are designed with internal frame structures, called cages, to allow collection of the dust on the outside of the bags. The dust cake is periodically removed by a pulsed jet of compressed air into the bag causing a sudden bag expansion. The dust is removed primarily by inertial forces when the bag reaches its maximum expansion.

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3

OVERVIEW OF AVAILABLE METHODS

3.1   DESCRIPTION OF EMISSION ESTIMATION METHODOLOGIES

There are several available methods for estimating emissions from secondary metal processing facilities. The choice of method depends on how the estimate will be used and the degree of accuracy required. In others, the availability of data or existing guidance from EPA or industry trade associations and the amount of available resources may determine the method. Regulatory agency requirements may establish minimum requirements for preparing estimates that limit the choice of method to be used for a facility or process.

Generally, methods that use site-specific data, such as stack sampling data, are preferred over methods that use industry averaged data, such as *AP-42* emission factors. Stack sampling data produce a more accurate estimate of emissions on a facility basis. However, industry averages may better represent emissions across multiple facilities and over longer time periods than limited site-specific data. This section presents the available methods for estimating emissions from secondary metal processing facilities. The methods are not listed in any particular order. Preferred estimation methods are identified on a pollutant basis; ranking of these methods is based on the accuracy of the resulting estimate without regard for cost or other resources.

3.1.1   STACK SAMPLING

Stack sampling provides site-specific data that can be used to estimate emissions. These data include pollutant concentrations in the stack gas and the stack gas volumetric flow rate. An emission rate for a particular pollutant is estimated by multiplying the pollutant concentration in the stack gas by the volumetric flow rate.

Two methods are typically used to measure pollutant concentrations in the stack gas: (1) manual methods and (2) instrument analyzer methods. The manual methods involve a probe inserted into the stack through which a stream of the exhaust gas is extracted using a vacuum pump. Constituents (pollutants) of the gas are collected in or on various media and the volume of gas sampled is measured. The collection media undergo laboratory analyses to identify the type and mass of pollutant(s) collected. Pollutant concentrations are then determined by dividing the mass of pollutant collected by the volume of gas sampled. The sampling method is selected based on the pollutant of interest.

Instrument analyzers measure pollutant concentrations directly but do not "collect" the pollutants. Similar to the manual method, a probe is inserted into the stack and a sample of the gas stream is continuously withdrawn. The sample passes through an electronic instrument that is calibrated to respond to the pollutant of interest and that indicates the pollutant concentration on a volume basis, usually expressed as parts per million by volume (ppmv). The concentration of the pollutant on a volume basis is then converted to a mass

basis using the ideal gas law adjustments for nonideal conditions, and the molecular weight of the pollutant. The instrument analyzers used for stack sampling are often identical to those used in continuous emission monitoring systems.

To determine the stack gas volumetric flow rate, the second parameter needed for the emission estimate, the cross-sectional area of the stack is multiplied by the stack gas velocity. The stack area is obtained by direct measurement of the stack dimensions (diameter or length and width). The velocity may be measured with Pitot tubes or with electronic instruments.

Stack tests are usually performed during operating conditions that are representative of the normal operation of the process. Thus, although stack sampling provides a "snapshot" of emission levels during the stack test, the results are considered to represent emissions during routine operation. A discussion of the sampling and analytical methods available for each pollutant is provided in the Emission Inventory Improvement Program (EIIP) document Chapter 1 of this volume, *Introduction to Stationary Point Source Emissions Inventory Development.*

Some state agencies may require facilities to perform stack tests under "worst case" conditions to determine maximum emission levels. During such tests, the facility may be operating at maximum capacity or under other conditions that maximize emissions. Emissions data generated during these tests overestimate emissions during routine operation. However, these peaks can be used to establish a better emissions profile where the facility has periodic peak releases.

3.1.2 EMISSION FACTORS

Emission factors are available for many secondary metal processes and are based on the results of emission tests or studies performed at one or more facilities. Emission factors are usually developed by correlating an emission rate to a production rate. For example, if an emission rate developed from stack testing data is estimated in units of pounds per hour and the production rate from the emission source (process) is measured in tons per hour, then an emission factor is calculated by dividing the emission rate by the production rate. Chapter 1 of this volume contains a detailed discussion of the reliability and quality of emission factors.

EPA maintains a compilation of emission factors in *AP-42* for criteria pollutants and HAPs (EPA, 1995). A supplementary source of criteria and HAP emission factors is the Factor Information Retrieval system (FIRE) (EPA, 1994). Chapter 1 of this volume provides a more complete discussion of available information sources for locating, developing, and using emission factors as an estimation technique.

3.1.3 CONTINUOUS EMISSION MONITORING SYSTEMS (CEMS)

A CEMS consists of one or more instrument analyzers that are used to measure stack gas pollutant concentrations continuously over a period of time. Instrument analyzers are described in Section 3.1.1. Instrument analyzers used for CEMS differ from those used for stack sampling in that they are permanently installed in a fixed location. In addition, the

CEMS method for determining pollutant concentrations is different from the stack sampling method in that stack sampling measures emissions over a limited period of time, usually a few hours, while a CEMS continuously measures emissions over extended periods of time, such as days, weeks, and even months. Thus, emissions estimates developed from CEMS data are more representative of actual conditions than estimates developed from stack sampling data.

Similar to the stack sampling method, the pollutant concentrations measured by the CEMS on a volume basis are converted to a mass basis and multiplied by the stack gas volumetric flow rate to estimate emission rates. Stack gas flow rates can be measured with an instrument, but they are typically determined using manual methods (e.g., Pitot tube).

3.1.4 MATERIAL BALANCE

The material balance method for estimating emissions compares the total amount of a raw material entering a process to the amount of material leaving the process as product and waste. Emissions are estimated by assuming the difference between the total amount of material used and the amount of material recovered, disposed of as waste, and retained in the product is emitted to the atmosphere.

3.2 COMPARISON OF AVAILABLE EMISSION ESTIMATION METHODOLOGIES

Table 9.3-1 identifies the preferred (number 1) and alternative emission estimation approaches (numbers 2-4) for selected pollutants. For the pollutant of interest, the reader should first decide whether the emissions are collected and vented from a stack, or are fugitive in nature. Using Table 9.3-1, the reader can then identify the preferred and alternative method(s). The reader should note that, for some processes and operations, it may not be practical to use the preferred method and an alternative method must be selected instead. For example, although stack sampling and CEMs are listed in Table 9.3-1 as the preferred method for several pollutants, it may not be practical to use either method for some processes because of high exhaust gas temperatures. In addition, for some processes, an alternative method may be selected. For example, although Table 9.3-1 identifies stack sampling as the preferred method for estimating VOC emissions and emission factors as an alternative method, there are some processes, such as scrap pretreatment, where emission factors may be selected as the method of choice. The inventory preparer and, where appropriate, the cognizant air quality agency representative must decide whether to take cost and air pollution control requirements into account in choosing an emission estimation approach. In selecting a method, other considerations should include the time interval for the emission estimate (e.g., hourly, annual) and the data quality. The quality of the data will depend on multiple factors including the number and accuracy of data points to be used in the estimate and the representativeness of the data points. Chapter 1 of this document describes the limitations of the available emission estimation methodologies and factors to consider in the use of each method.

TABLE 9.3-1

SUMMARY OF PREFERRED AND ALTERNATIVE EMISSION ESTIMATION METHODS FOR SECONDARY METAL PROCESSING[a,b]

Pollutant[c]	CEMS	Stack Sampling Data	Material Balance	EPA/State Emission Factors
PM - process		1		2
PM- fugitive				1
PM_{10} - process		1		2
PM_{10} - fugitive				1
SO_2 - process	1	2	3	4
SO_2 - combustion	1	2	3	4
NO_x	1	2		3
CO	1	2		3
VOC		1	3	2
THC	1	2	4	3
Speciated organics		1		2
Metals		1		2

[a] Preferred = number 1. Alternative = numbers 2-4.

[b] Preferred emission estimation approaches do not include considerations such as cost. The costs, benefits, and relative accuracy should be considered prior to method selection. The reader is advised to check with their local air pollution control agency before choosing a preferred emission estimation approach.

[c] PM   = Particulate matter.

PM_{10} = PM less than, or equal to, 10 microns in aerodynamic equivalent diameter.

VOC = Volatile organic compounds.

THC = Total hydrocarbons.

3.2.1 STACK SAMPLING

Stack sampling is the most accurate emission estimation methodology for process volatile organic compounds (VOCs), speciated organics, PM, PM_{10} (particulate matter less than or equal to 10 µm), and metals. EPA reference methods and other standard methods are available for several pollutants and can be used to obtain accurate emissions estimates for a particular facility.

3.2.2 EMISSION FACTORS

Due to their availability, ease of use, and low cost, emission factors have gained wide acceptance in the industry and are commonly used to prepare emission inventories. However, emission factors are often averages of limited industry-wide emissions data and so vary in their degree of quality. The underlying data and the resulting average may also inadequately represent emissions for an individual facility within that industry, introducing further error.

3.2.3 CEMS

Continuous emissions monitoring systems are typically used at secondary metal processing facilities to measure SO_2, NO_x, CO, and THC emissions from processes that include combustion sources, such as drying and melting furnaces. Continuous emissions monitoring systems are used when detailed records of emissions are needed over time. EPA reference methods and other standards that use CEMS are available which improves the accuracy and comparability of the resulting data. Emissions estimates developed from CEM data can be equally accurate as those developed from stack sampling data for these pollutants.

3.2.4 MATERIAL BALANCE

An emission estimate based on a material balance approach is the result of calculations with several inputs. Consequently, the accuracy of the emissions estimate is directly related to the accuracy of the values for the inputs. Where inputs to the calculations can not be measured directly (e.g., the amount of material leaving a process in the wastewater), the accuracy of the resulting emissions estimate may vary greatly.

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4

PREFERRED METHODS FOR ESTIMATING EMISSIONS

In Section 3 (Table 9.3-1), CEMS, stack sampling, and emission factors were identified as the preferred methods for estimating emissions from secondary metal processing operations. Optimally, the inventory preparer elects to use the preferred method to estimate emissions. However, considerations such as the availability of resources often dictate the choice of method. Because some state agencies may specify the method(s) to be used, the inventory preparer should contact the appropriate state or local air quality agency before deciding on which emission estimation methodology to use.

This section describes how the preferred methods should be used for estimating emissions.

4.1 EMISSION ESTIMATIONS USING STACK SAMPLING DATA

Stack sampling is the preferred method for estimating emissions for process PM, VOCs, speciated organics, and metals. To illustrate how the results are used to estimate emissions, an example using a PM test based on EPA Method 5 is shown below. To estimate emissions in pounds per hour, the pollutant concentration is determined and then multiplied by the stack gas volumetric flow rate. The test results are given in Table 9.4-1, Equations 9.4-1 and 9.4-2 are used to derive the estimates, and Example 9.4-1 shows the calculations used to estimate PM emissions.

TABLE 9.4-1

TEST RESULTS - METHOD 5

Parameter	Symbol	Run 1	Run 2	Run 3
Filter catch (grams)	C_f	0.0851	0.0449	0.0625
Standard metered volume (dscf)	$V_{m,STP}$	41.83	40.68	40.78
Volumetric flow rate (dscfm)	Q_d	17,972	17,867	17,914

Determine the PM concentration:

$$C_m = C_f / V_{m,STP} * 15.43 \qquad\qquad (9.4\text{-}1)$$

where:

C_m	= concentration of PM (grain/dry standard cubic feet [dscf])
C_f	= amount of PM collected on filter (grams)
$V_{m,STP}$	= volume of gas sampled at standard temperature and pressure (dscf)
15.43 grains	= 1 gram

Calculate the mass emission rate:

$$E_{PM} = C_m * Q_d * 60 * 1/7,000 \qquad\qquad (9.4\text{-}2)$$

where:

E_{PM}	= PM emissions (lb/hr)
Q_d	= stack gas volumetric flow rate (dry standard cubic feet per minute [dscfm])
60 minutes	= 1 hour
7,000 grains	= 1 pound

Example 9.4-1

PM emissions calculated using Equations 9.4-1 and 9.4-2 and the stack sampling data for Run 1 (presented in Table 9.4-1 are shown below).

$$
\begin{aligned}
C_m \quad &= \quad C_f / V_{m,STP} * 15.43 \\
&= \quad 0.085 \text{ grams}/41.83 \text{ dscf} * 15.43 \text{ grain/gram} \\
&= \quad 0.03 \text{ grain/dscf}
\end{aligned}
$$

$$
\begin{aligned}
E_{PM} \quad &= \quad C_m * Q_d * 60 * 1/7,000 \\
&= \quad 0.03 \text{ grain/dscf} * 17,972 \text{ dscf/min} * 60 \text{ min/hr} * \\
& \qquad 1 \text{ lb}/7,000 \text{ grain} \\
&= \quad 4.62 \text{ lb/hr}
\end{aligned}
$$

4.2 EMISSION ESTIMATIONS USING EMISSION FACTORS

Emission factors are the preferred method for fugitive PM emissions. They are also frequently used to estimate emissions when site-specific emissions data are unavailable. The basic equation for estimating emissions using an emission factor is:

$$E_x = EF_x * \text{Activity or Production Rate} \tag{9.4-3}$$

where:

E_x = emissions of pollutant x
EF_x = emission factor for pollutant x

Example 9.4-2 describes how emissions may be estimated using an emission factor.

Example 9.4-2

This example shows how potential hourly PM emissions may be calculated for a secondary lead reverberatory smelter using a PM emission factor from *AP-42*, Table 12.11-2. The lead smelter is assumed to operate 8,760 hours per year. Note that the emission factor is for an uncontrolled furnace.

EF_{PM}	=	323 lb PM/ton metal produced
Maximum metal production rate	=	50 ton/hr
PM emissions	=	EF_{PM} * metal production rate
	=	323 lb/ton * 50 ton/hr * 1 ton/2,000 lb * 8,760 hr/yr
	=	70,737 ton/yr

4.3 EMISSIONS ESTIMATING USING CEMS DATA

Use of CEMS is the preferred method for SO_2, NO_x, CO, and THC. Calculations to estimate emissions using CEMS data are very similar to those using stack sampling data. Continuous emissions monitoring systems measure pollutant concentrations on a volume basis and the concentrations must be converted to a mass basis when calculating emissions. The mass-basis concentrations are then multiplied by the stack gas volumetric flow rate to estimate emissions. Equations 9.4-4 and 9.4-5 may be used to estimate emissions using CEMS data. Example 9.4-3 shows how the equations are used.

$$E_x = \frac{(C_v * MW * Q_d * 60)}{(V * 10^6)}$$ (9.4-4)

where:

E_x = hourly emissions of pollutant x (lb/hr)
C_v = pollutant concentration in ppmvd (part/10^6)
MW = molecular weight of the pollutant (lb/lb·mole)
Q_d = stack gas volumetric flow rate (dscf/min)
V = volume occupied by one mole of ideal gas at standard
     temperature and pressure (385.5 ft^3/lb·mole at 68°F and 1 atm)
60 minutes = 1 hour

Emissions in tons per year can be calculated by multiplying the emission rate in pounds per hour by the number of annual operating hours (OpHrs) as shown in Equation 9.4-5.

$$E_{tpy,x} = E_x * OpHrs/2000$$ (9.4-5)

where:

$E_{tpy,x}$ = annual emissions of pollutant x (ton/yr)
E_x = hourly emissions of pollutant x (lb/hr)
OpHrs = annual operating hours (hr/yr)
2,000 pounds = 1 ton

Example 9.4-3

Given:

SO$_2$ concentration = 175 ppmvd
SO$_2$ molecular weight = 64 lb/lb·mole
Stack gas volumetric flow rate = 1,500 dscf/min
Annual operating hours per year = 2,000

Then, using equation 9.4-4:

$$E_{SO2} \quad = \quad (C_v * MW * Q_d * 60)/(V * 10^6)$$
$$= \quad (175 \text{ ppmvd} * 64 \text{ lb/lb·mole} * 15,000 \text{ dscf/min} *$$
$$60 \text{ min/hr})/(385.5 \text{ dscf/lb·mole} * 10^6)$$
$$= \quad 26 \text{ lb/hr}$$

Annual emissions are calculated using Equation 9.4-5:

$$E_{tpy,SO2} \quad = \quad E_{SO2} * OpHrs/2,000$$
$$= \quad 26 \text{ lb/hr} * 2,000 \text{ hr/yr} * 1 \text{ ton/2,000 lb}$$
$$= \quad 26 \text{ ton/yr}$$

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5

ALTERNATIVE METHODS FOR ESTIMATING EMISSIONS

All of the methods described in Section 4 as preferred methods are also alternatives for some pollutants and some processes (refer to Table 9.3-1). Only the material balance approach is not a preferred method for any of the emission sources at secondary metal processing operations. The material balance approach is described below.

The material balance approach accounts for all the material (pollutant) entering and leaving a process. Measurements or estimates are made of the total amount of material entering a process; the fraction of the material in the product leaving the process; the fraction of the material that is recovered and used again; and the fraction of the material leaving the process in water and solid waste streams. The fraction of material unaccounted for is assumed to be emitted as a pollutant. The basic equation for estimating emissions using the material balance approach is:

$$E_x = (Q_{in} - Q_{out}) * C_x \qquad (9.5\text{-}1)$$

where:

E_x	=	Total emissions of pollutant x (lb/hr)
Q_{in}	=	Material entering the process (gal/hr)
Q_{out}	=	Material leaving the process as waste, recovered, or in product (gal/hr)
C_x	=	Concentration of pollutant x (lb/gal)

The term Q_{out} may actually involve several different "fates" for an individual pollutant. This could include the amount recovered (or recycled), the amount leaving the process in the product, the amount leaving the process in the wastewater, or the amount of material shipped off-site as hazardous waste. A thorough knowledge of the different fates for the pollutant of interest is necessary for an accurate emissions estimate. Example calculation 9.5-1 illustrates the use of Equation 9.5-1.

Example 9.5-1

This example shows how hourly VOC emissions may be calculated for solvent cleaning of scrap metal.

$$Q_{in} = 10 \text{ gal/hr}$$
$$Q_{out} = 9.5 \text{ gal/hr}$$
$$C_{VOC} = 4.8 \text{ lb VOC/gal}$$

$$E_{VOC} = (Q_{in} - Q_{out}) * C_{VOC}$$
$$E_{VOC} = (10 \text{ gal/hr} - 9.5 \text{ gal/hr}) * 4.8 \text{ lb VOC/gal}$$
$$E_{VOC} = 2.4 \text{ lb VOC/hr}$$

6

QUALITY ASSURANCE/QUALITY CONTROL

Quality assurance (QA) and quality control (QC) are essential elements in producing high quality emission estimates and should be included in all methods used to estimate emissions. QA/QC of emissions estimates is accomplished through a set of procedures that ensure the quality and reliability of data collection and processing. These procedures include the use of appropriate emission estimation methods, reasonable assumptions, data reliability checks, and accuracy/logic checks of calculations. The *QA Source Document*, Volume VI of this series, describes methods and tools for performing these procedures. In addition, Chapter 1 of this volume *Introduction to Stationary Point Source Emission Inventory Development* provides QA/QC guidance for preparing point source emission estimates. The following sections discuss QA/QC considerations that are specific to the emission estimation methods presented in this chapter.

6.1 QA/QC CONSIDERATIONS FOR USING STACK SAMPLING AND CEMS DATA

In reviewing stack sampling or CEMS data, the first consideration is whether the method measures the pollutant of interest, or can only be used as a surrogate. Next, the reviewer should determine whether the sampling conditions represent the operating conditions of interest for the emission estimate. For example, if the data are to be used to estimate emissions during typical operations, then sampling should have been done during typical operating conditions.

For CEMS, the accuracy of the data depend heavily on maintaining calibration. Thus the reviewer should evaluate the calibration information. Parameters that should be evaluated in QA/QC of stack sampling and CEMS data and the acceptance criteria for each are presented in Chapter 1 of this volume.

6.2 QA/QC CONSIDERATIONS FOR USING EMISSION FACTORS

When using emission factors to estimate emissions from a source, the applicability and representativeness of the emission factor are the first two criteria to consider. To assess applicability, the reviewer needs to examine how closely the process of interest matches the process for which the emission factor is available. For example, metal refining emission factors cannot be used to estimate melting emissions. Similarly, the reviewer should look at how well the range of conditions on which the available emission factor is based compares to the conditions of interest. For example, an emission factor that is based on processes with 100 tons per hour is not the best emission factor for a 10 ton per hour process.

EPA emission factors often have a quality rating. The lower the quality rating of a factor, the more likely that the factor may not be representative of the source population. The reliability and uncertainty of using emission factors as an emission estimation method are discussed in the QA/QC Section of Chapter 1 of this volume.

6.3 QA/QC CONSIDERATIONS FOR USING MATERIAL BALANCES

The material balance method for estimating emissions may take various approaches, thus the QA/QC considerations vary and may be specific to an approach. Generally, the fates of all materials of interest are identified then the quantity of material allocated to each fate determined. Identifying the fates, such as material contained in a product or material leaving the process in the wastewater, is usually straightforward. However, estimating the amount of material allocated to each fate is sometimes complicated and is the prime QA/QC consideration in using the material balance approach. Amounts obtained by direct measurement are more accurate and produce emission estimates of higher quality than those obtained by engineering or theoretical calculations. QA/QC of an emissions estimate developed from a material balance approach should include a thorough check of all assumptions and calculations. A reality check looking at the estimate in the context of the overall process is also recommended.

6.4 DATA ATTRIBUTE RATING SYSTEM (DARS) SCORES

One measure of emission inventory data quality is the DARS score. The *QA Source Document* (Volume VI, Chapter 4) and the QA/QC Section in Chapter 1 of this volume provide complete discussions of the DARS. The DARS assumes "activity" data and "factor" data are used to generate an inventory and provides criteria that are used to assign a numerical score to each data set. The activity score is multiplied by the factor score to obtain a composite score for the emissions estimate. The highest possible value for an individual or composite score is 1.0. The composite score for the emissions estimate can be used to evaluate the quality and accuracy of the estimate.

The DARS was used to evaluate the methods for estimating emissions that are presented in this chapter to provide an idea of the relative quality of each method. This was accomplished by assuming an inventory was developed using each method and using the DARS to score each inventory. Because the inventories are hypothetical, it was necessary to make some additional assumptions. The first assumptions were that emissions are for a one-year period from one process or from one facility under normal operating conditions. All data used were assumed to be reasonably accurate. Some scores are expressed as a range with the lower value representing an estimate developed from low to medium quality data and the upper value representing an estimate based on relatively high quality data. Tables 9.6-1 through 9.6-5 present the DARS scores for the different emission estimation methods presented in this chapter.

Comparing the scores for the different methods, the preferred methods (CEMS, stack sampling, and emission factors) received higher scores and the alternative method (material balance) received the lowest. The CEMS method for estimating emissions received the highest DARS score (0.98 - 1.0) as shown in Table 9.6-1. Note that the score is based on

TABLE 9.6-1

DARS SCORES: CEMS DATA

Attribute	Factor Score	Activity Score	Emissions Score	Factor Assumptions	Activity Assumptions
Measurement/Method	1.0	0.9 - 1.0	0.9 - 1.0	Continuous or near continuous measurement of activity; data capture >90%.	Lower scores reflect direct, intermittent measurement of activity; upper scores reflect direct, continuous measurement of activity.
Source Specificity	1.0	1.0	1.0	Factor developed specifically for the intended source.	Activity data represents the emission process exactly.
Spatial Congruity	1.0	1.0	1.0	Factor developed for and specific to the given spatial scale (one facility).	Activity data developed for and specific to the inventory area (one facility).
Temporal Congruity	1.0	1.0	1.0	Factor measured continuously, or near continuously, for a period of one year.	Activity data measured continuously, or near continuously, for a period of one year.
Composite Score	1.0	0.98 - 1.0	0.98 - 1.0		

TABLE 9.6-2

DARS SCORES: STACK SAMPLING DATA

Attribute	Factor Score	Activity Score	Emissions Score	Factor Assumptions	Activity Assumptions
Measurement/ Method	0.7 - 0.9	0.9 - 1.0	0.63 - 0.9	Lower score reflects a small number of tests at typical loads; upper score represents numerous tests over a range of loads.	Lower score reflects direct, intermittent measurement of activity; upper score reflects direct, continuous measurement of activity.
Source Specificity	1.0	1.0	1.0	Factor developed specifically for the intended source.	Activity data represents the emission process exactly.
Spatial Congruity	1.0	1.0	1.0	Factor developed for and specific to the given spatial scale (one facility).	Activity data developed for and specific to the inventory area (one facility).
Temporal Congruity	0.7 - 0.9	0.7 - 0.9	0.49 - 0.81	Lower score reflects factor developed for a shorter time period with moderate to low temporal variability; upper score reflects factor derived from an average of numerous tests over the year.	Lower score reflects activity data representative of short period of time with low to moderate temporal variability; upper score reflects activity data measured numerous times over the year.
Composite Score	0.85 - 0.98	0.90 - 0.98	0.78 - 0.95		

TABLE 9.6-3

DARS SCORES: SOURCE-SPECIFIC EMISSION FACTOR DATA[a]

Attribute	Factor Score	Activity Score	Emissions Score	Factor Assumptions	Activity Assumptions
Measurement/ Method	1.0	0.9 - 1.0	0.9 -1.0	Continuous or near continuous measurement of pollutant.	Lower scores reflect direct, intermittent measurement of activity; upper scores reflect direct, continuous measurement of activity.
Source Specificity	0.8	1.0	0.8	Factor developed for a similar category; low variability.	Activity data represents the emission process exactly.
Spatial Congruity	0.9	1.0	0.9	Factor developed from a facility of similar size; low variability.	Activity data developed for and specific to the inventory area (one facility).
Temporal Congruity	1.0	0.7 - 0.9	0.7 - 0.9	Factor developed for and applicable to a period of one year.	Lower score reflects activity data representative of short period of time with low to moderate temporal variability; upper score reflects activity data measured numerous times over the year.
Composite Score	0.93	0.90 - 0.98	0.83 - 0.90		

[a] Assumes emission factor was developed from an identical or similar facility and is of high quality.

TABLE 9.6-4

DARS SCORES: AP-42 EMISSION FACTOR DATA

Attribute	Factor Score	Activity Score	Emissions Score	Factor Assumptions	Activity Assumptions
Measurement/ Method	0.3 - 0.6	0.9 - 1.0	0.27 - 0.6	Lower score reflects a factor of poor quality; upper score reflects a factor of high quality.	Lower scores reflect direct, intermittent measurement of activity; upper scores reflect direct, continuous measurement of activity.
Source Specificity	0.8	1.0	0.8	Factor developed from superset of intended source category; low variability.	Activity data represents the emission process exactly.
Spatial Congruity	0.1 - 0.9	1.0	0.1 - 0.9	Lower score reflects a factor of low quality developed for an unknown spatial scale; upper score reflects a high quality factor developed from a similar (size) facility.	Activity data developed for and specific to the inventory area (one facility).
Temporal Congruity	0.1 - 0.9	0.7 - 0.9	0.7 - 0.81	Lower score reflects a low quality factor, temporal basis unknown; upper score reflects a high quality factor derived from an average of numerous tests.	Lower score reflects activity data representative of short period of time with low to moderate temporal variability; upper score reflects activity data measured numerous times over the year.
Composite Score	0.3 - 0.8	0.90 - 0.98	0.47 - 0.78		

TABLE 9.6-5

DARS SCORES: MATERIAL BALANCE DATA[a]

Attribute	Factor Score	Activity Score	Emissions Score	Factor Assumptions	Activity Assumptions
Measurement/ Method	0.1	1.0	0.1	Factor is based on expert judgment.	Direct, continuous measurement of activity.
Source Specificity	1.0	1.0	1.0	Factor developed specifically for the intended source.	Activity data represents the emission process exactly.
Spatial Congruity	1.0	1.0	1.0	Factor developed for and specific to the given spatial scale.	Activity data developed for and specific to the inventory area (one facility).
Temporal Congruity	1.0	1.0	1.0	Factor developed for and applicable to the same temporal scale.	Activity data specific to one year.
Composite Score	0.78	1.0	0.78		

[a] The "activity" is the amount of material (pollutant) used in a year and is directly measurable. The "factor" is the fraction of material used that is emitted to the atmosphere. The fraction is based on engineering calculations and is assumed to remain constant over the year.

the assumption that the factor data were measured continuously during the year (the inventory period). Also, note that if factor data and activity data are measured continuously over the year, a perfect score (1.0) is possible for an emissions estimate when using this method.

The stack sampling approach received the next highest overall score (0.78 - 0.95). As indicated by the scores, the major parameters affecting the quality of stack sampling data are the number of tests (range of loads, and numerous tests performed over the year) and the frequency of measurement of activity data (intermittent or continuous). A high DARS score for an emissions estimate based on stack sampling data is possible if the factor data are the result of numerous tests performed during typical operations and the activity data are the result of continuous measurements over the inventory period.

In using the DARS to score the emission factor approach, two examples are provided in order to illustrate how the representativeness (or quality) of an emission factor may vary and how emission factor quality affects emission estimates. The first example, shown in Table 9.6-3, assumes the emission factor was developed from a facility that is similar, if not identical, to the facility for which the emissions estimate was made. Because the emission factor represents a facility similar to the inventory facility, a high score is assigned. Assuming the activity data were measured continuously, a composite score of 0.83 to 0.90 is assigned. The second example, provided in Table 9.6-4, assumes that an *AP-42* emission factor was used to generate the emissions estimate and a score of 0.47 to 0.78 is assigned. The lower value reflects the score assigned to an estimate based on a lower quality emission factor while the upper value reflects an estimate based on a higher quality emission factor. As shown by the scores in the two tables, the quality of an emissions estimate developed from emission factors is directly affected by the quality of the emission factors and can vary greatly. The scores also indicate that a source-specific emission factor may produce an emissions estimate of higher quality than an estimate developed from an *AP-42* factor.

The material balance approach for estimating emissions received the lowest DARS score (0.78). This score is based on the assumption that some of the data are based on "expert judgment." Normally, when a material balance approach is used to estimate emissions from secondary metal processes, it is because the data have not been or cannot be measured directly and must be estimated using professional judgment or theoretical calculations. Consequently, because the emission estimate is not based on direct measurement of data, a relatively low DARS score is assigned to the estimate.

The examples provided in the tables are given as an illustration of the relative quality of each estimation method. If the DARS was applied to actual inventories developed from the preferred and alternative methods and data of reasonably good quality were used for each method, the scores could be different; however, the relative ranking of the methods would be expected to remain the same.

7

DATA CODING PROCEDURES

This section describes the methods and codes available for characterizing emission sources at secondary metal processing facilities. Consistent categorization and coding will result in greater uniformity among inventories. In addition, the procedures described here will assist the reader who is preparing data for input to the Aerometric Information Retrieval System (AIRS) or a similar database management system (EPA, 1990). The use of Source Classification Codes (SCCs) provided in Tables 9.7-1 through 9.7-7 is recommended for describing various secondary metal processing operations. Refer to the Clearinghouse for Inventories and Emission Factors (CHIEF) bulletin board for a complete listing of SCCs for secondary metal processing facilities.

7.1 SCCs

SCCs for some of the secondary metal processing operations are presented in Tables 9.7-1 through 9.7-7. The units presented in the table are intended to be used with emission data that are input to AIRS. Emission data may be available, and can be used, in different units. A separate table for each metal has been provided. These include the following:

- Aluminum;

- Copper;

- Iron;

- Lead;

- Magnesium;

- Steel; and

- Zinc.

7.2 AIRS CONTROL DEVICE CODES

Control device codes applicable to secondary metal processing operations are presented in Table 9.7-8. These should be used to enter the type of applicable emission control device into the AIRS Facility Subsystem (AFS). The "099" control code may be used for miscellaneous control devices that do not have a unique identification code.

TABLE 9.7-1

SOURCE CLASSIFICATION CODES FOR SECONDARY ALUMINUM PRODUCTION PROCESSES (SIC CODES 3341, 3353, 3354, 3355, 3363, 3365)

Process Description	SCC	Units (Pounds per ____)
Process Emissions		
Sweating Furnace - Reverberatory	3-04-001-01	Tons Produced
Smelting Furnace/Crucible	3-04-001-02	Tons of Metal Produced
Smelting Furnace/Reverberatory	3-04-001-03	Tons of Metal Produced
Fluxing: Chlorination	3-04-001-04	Tons of Chlorine Used
Fluxing: Fluoridation	3-04-001-05	Tons of Metal Produced
Degassing	3-04-001-06	Tons of Metal Produced
Hot Dross Processing	3-04-001-07	Tons of Metal Produced
Crushing/Screening	3-04-001-08	Tons of Metal Produced
Burning/Drying	3-04-001-09	Tons of Metal Produced
Annealing Furnace	3-04-001-12	Tons of Metal Produced
Slag Furnace	3-04-001-13	Tons of Metal Produced
Sweating Furnace - Grate	3-04-001-15	Tons Produced
Dry Milling of Dross	3-04-001-16	Tons of Metal Produced
Wet Milling of Dross	3-04-001-17	Tons of Metal Produced
Leaching	3-04-001-18	Tons of Metal Produced
Demagging	3-04-001-30	Tons of Metal Produced
Material Handling	3-04-001-60	Tons of Material
Other Not Classified	3-04-001-99	Tons Produced

TABLE 9.7-1

(CONTINUED)

Process Description	SCC	Units (Pounds per ___)
Metal Product Shaping		
Foil Rolling	3-04-001-10	Tons of Product
Foil Converting	3-04-001-11	Tons Produced
Pouring/Casting	3-04-001-14	Tons of Metal Charged
Can Manufacture	3-04-001-20	Tons Produced
Rolling/Drawing/Extruding	3-04-001-50	Tons Produced
Fugitive Emissions		
Raw Material Charging	3-04-001-31	Tons of Material Charged
Raw Material Storage	3-04-001-32	Tons of Material Stored
Tapping	3-04-001-33	Tons of Metal Produced
Miscellaneous Fugitive Emissions	3-04-888-01 to -05	Tons Product

TABLE 9.7-2

SOURCE CLASSIFICATION CODES FOR SECONDARY COPPER SMELTING AND ALLOYING
(SIC CODES 3341, 3364, 3366)

Process Description	SCC	Units (Pounds per ___)
Process Emissions		
Copper Smelting-Blast Furnace (Cupola)	3-04-002-03	Tons of Charge
Electric Induction Furnace	3-04-002-04	Tons of Charge
Preparation-Scrap Dryer (Rotary)	3-04-002-07	Tons of Charge
Preparation-Wire Burning Incinerator	3-04-002-08	Tons of Charge
Preparation-Sweating Furnace	3-04-002-09	Tons of Charge
Cupola-Charge with Scrap Copper	3-04-002-10	Tons of Charge
Cupola-Charge with Insulated Copper Wire	3-04-002-11	Tons of (Coke-free) Charge
Cupola-Charge with Scrap Copper and Brass	3-04-002-12	Tons of Charge
Cupola-Charge with Scrap Iron	3-04-002-13	Tons Ore Processed
Reverberatory Refining Furnace-Charge with Copper	3-04-002-14	Tons of Charge
Reverberatory Refining Furnace-Charge with Brass and Bronze	3-04-002-15	Tons of Charge
Rotary Refining Furnace-Charge with Copper	3-04-002-16	Tons of Charge
Rotary Refining Furnace-Charge with Brass and Bronze	3-04-002-17	Tons of Charge
Crucible and Pot Furnace-Charge with Copper	3-04-002-18	Tons of Charge
Crucible and Pot Furnace-Charge with Brass and Bronze	3-04-002-19	Tons of Charge
Electric Arc Furnace-Charge with Copper	3-04-002-20	Tons of Charge
Electric Arc Furnace-Charge with Brass and Bronze	3-04-002-21	Tons of Charge
Electric Induction-Charge with Copper	3-40-002-23	Tons of Charge

TABLE 9.7-2

(CONTINUED)

Process Description	SCC	Units (Pounds per _____)
Electric Induction-Charge with Brass and Bronze	3-04-002-24	Tons of Charge
Pretreatment-Scrap Dryer	3-04-002-31	Tons of Charge
General-Casting (and Shot Production)	3-04-002-39	Tons of Casting Produced
Holding Furnace-Charge with Copper	3-04-002-40	Tons of Charge
Holding Furnace-Charge with Brass and Bronze	3-04-002-41	Tons of Charge
Reverberatory Refining Furnace-Charge with Other Alloy (7%)	3-04-002-42	Tons Ore Processed
Reverberatory Refining Furnace-Charge with High Lead Alloy (58%)	3-04-002-43	Tons Ore Processed
Reverberatory Refining Furnace-Charge with Red/Yellow Brass	3-04-002-44	Tons Ore Processed
Converter-Charge with Copper	3-04-002-50	Tons of Charge
Converter-Charge with Brass and Bronze	3-04-002-51	Tons of Charge
Other Not Classified	3-04-002-99	Tons Produced
Fugitive Emissions		
Scrap Metal Pretreatment	3-04-002-30	Tons of Charge
Scrap Dryer	3-04-002-31	Tons of Charge
Wire Incinerator	3-04-002-32	Tons of Charge
Sweating Furnace	3-04-002-33	Tons of Charge
Cupola Furnace Fugitives	3-04-002-34	Tons of Charge
Reverberatory Furnace Fugitives	3-04-002-35	Tons of Charge
Rotary Furnace Fugitives	3-04-002-36	Tons of Charge
Crucible or Pot Furnace Fugitives	3-04-002-37	Tons of Charge

TABLE 9.7-2

(CONTINUED)

Process Description	SCC	Units (Pounds per ____)
Electric Induction Furnace Fugitives	3-04-002-38	Tons of Charge
Casting Operations Fugitives	3-04-002-39	Tons of Castings Produced
Coke Storage	3-05-102-05	Tons Processed
Limestone Storage	3-05-102-08	Tons Processed
Dry Chemical Storage/Specify in Comments	3-05-102-98	Tons Processed
Open Stockpile: Coke	3-05-103-04	Tons Processed
Open Stockpile: Limestone	3-05-103-05	Tons Processed
Open Stockpile: Scrap Metal	3-05-103-07	Tons Processed
Open Stockpile: Sulfur	3-05-103-08	Tons Processed
Open Stockpile: Mineral/Specify in Comments Field	3-05-103-98	Tons Processed
Other Not Classified Bulk Materials Fugitives	3-05-103-99	Tons Processed
Miscellaneous Fugitive Emissions	3-04-888-01 to -05	Tons Product

TABLE 9.7-3

**SOURCE CLASSIFICATION CODES FOR SECONDARY IRON PROCESSES
(SIC CODE 3321)**

Process Description	SCC	Unit (Pounds per____)
Process Emissions		
Cupola Furnace	3-04-003-01	Tons Metal Charged
Reverberatory Furnace	3-04-003-02	Tons Metal Charged
Electric Induction Furnace	3-04-003-03	Tons Metal Charged
Electric Arc Furnace	3-04-003-04	Tons Metal Charged
Annealing Operations	3-04-003-05	Tons Processed
Inoculation	3-04-003-10	Tons Metal Inoculated
Scrap Metal Preheating	3-04-003-14	Tons of Metal
Charge Handling	3-04-003-15	Tons Metal Charged
Tapping	3-04-003-16	Tons Metal Produced
Pouring Ladle	3-04-003-17	Tons Metal Charged
Pouring, Cooling	3-04-003-18	Tons Gray Iron Produced
Core Making, Baking	3-04-003-19	Tons Gray Iron Produced
Pouring/Casting	3-04-003-20	Tons of Metal Charged
Magnesium Treatment	3-04-003-21	Tons Gray Iron Produced
Refining	3-04-003-22	Tons Gray Iron Produced
Castings Cooling	3-04-003-25	Tons Metal Charged
Miscellaneous Casting-Fabricating	3-04-003-30	Tons Processed
Casting Shakeout	3-04-003-31	Tons Metal Charged
Casting Knockout	3-04-003-32	Tons Sand Handled
Shakeout Machine	3-04-003-33	Tons Sand Handled
Grinding/Cleaning	3-04-003-40	Tons Metal Charged
Casting Cleaning/Tumblers	3-04-003-41	Tons of Castings Cleaned

TABLE 9.7-3

(CONTINUED)

Process Description	SCC	Units (Pounds per _____)
Casting Cleaning/Chippers	3-04-003-42	Tons Castings Cleaned
Sand Grinding/Handling	3-04-003-50	Tons Sand Handled
Core Ovens	3-04-003-51	Tons Sand Handled
Sand Grinding/Handling	3-04-003-52	Tons of Metal Charged
Core Ovens	3-04-003-53	Tons Metal Charged
Core Ovens	3-04-003-54	Gallons Core Oil Used
Sand Dryer	3-04-003-55	Tons Sand Handled
Sand Silo	3-04-003-56	Tons Sand Handled
Conveyors/Elevators	3-04-003-57	Tons Sand Handled
Sand Screens	3-04-003-58	Tons Sand Handled
Castings Finishing	3-04-003-60	Tons Metal Charged
Shell Core Machine	3-04-003-70	Tons Cores Produced
Core Machines/Other	3-04-003-71	Tons Cores Produced
Other Not Classified	3-04-003-98	Gallons
Other Not Classified	3-04-003-99	Tons Metal Charged
Fugitive Emissions		
Conveyors/Elevators	3-04-003-57	Tons of Sand Handled
Unloading - Other Not Classified	3-05-103-99	Tons Processed
Coke Unloading	3-05-104-04	Tons Processed
Limestone Unloading	3-05-104-05	Tons Processed
Scrap Metal Unloading	3-05-104-07	Tons Processed
Unloading - General Mineral	3-05-104-98	Tons Processed

TABLE 9.7-4

SOURCE CLASSIFICATION CODES FOR SECONDARY LEAD PROCESSING
(SIC CODES 3341, 3364)

Process Description	SCC	Units (Pounds per ____)
Process Emissions		
Pot Furnace	3-04-004-01	Tons of Metal Charged
Reverberatory Furnace	3-04-004-02	Tons of Material Charged
Blast Furnace (Cupola)	3-04-004-03	Tons of Metal Charged
Rotary Sweating Furnace	3-04-004-04	Tons of Metal Charged
Reverberatory Sweating Furnace	3-04-004-05	Tons of Metal Charged
Pot Furnace Heater: Distillate Oil	3-04-004-06	1000 Gallons Burned
Pot Furnace Heater: Natural Gas	3-04-004-07	Million Cubic Fee Burned
Barton Reactor (Oxide Kettle)	3-04-004-08	Tons of Lead Oxide Produced
Casting	3-04-004-09	Tons of Lead Cast
Battery Breaking	3-04-004-10	Tons of Metal Charged
Scrap Crushing	3-04-004-11	Tons of Metal Charged
Agglomeration Furnace	3-04-004-15	Tons of Flue Dust Processed
Furnace Charging	3-04-004-16	Tons of Lead Produced
Furnace Lead/Slag Tapping	3-04-004-17	Tons of Lead Produced
Electric Furnace	3-04-004-18	Tons of Material Charged
Raw Material Dryer	3-04-004-19	Tons of Material Charged
Size Separation	3-04-004-24	Tons Processed
Kettle Refining	3-04-004-26	Tons of Lead Produced
Other Not Classified	3-04-004-99	Tons Processed
Fugitive Emissions		
Sweating Furnace	3-04-004-12	Tons of Material Charged
Smelting Furnace	3-04-004-13	Tons of Material Charged
Kettle Refining	3-04-004-14	Tons of Material Charged

TABLE 9.7-4

(CONTINUED)

Process Description	SCC	Units (Pound per ____)
Raw Material Unloading	3-04-004-20	Tons of Raw Material
Raw Material Transfer/Conveying	3-04-004-21	Tons of Raw Material
Raw Material Storage Piles	3-04-004-22	Tons of Raw Material
Slag Breaking	3-04-004-23	Tons Processed
Casting	3-04-004-25	Tons Lead Produced
Other Not Classified	3-04-004-99	Tons Processed

TABLE 9.7-5

SOURCE CLASSIFICATION CODES FOR SECONDARY MAGNESIUM SMELTING (SIC CODE 3341)

Process Description	SCC	Units (Pounds per ____)
Process Emissions		
Smelting - Pot Furnace	3-04-006-01	Tons Processed

TABLE 9.7-6

SOURCE CLASSIFICATION CODES FOR STEEL FOUNDRY PROCESSES
(SIC CODES 3324, 3325)

Process Description	SCC	Units (Pounds per _____)
Process Emissions		
Electric Arc Furnace	3-04-007-01	Tons Metal Processed
Open Hearth Furnace	3-04-007-02	Tons Metal Processed
Open Hearth Furnace with Oxygen Lance	3-04-007-03	Tons Metal Processed
Heat Treating Furnace	3-04-007-04	Tons Metal Processed
Electric Induction Furnace	3-04-007-05	Tons Metal Processed
Sand Grinding/Handling	3-04-007-06	Tons Sand Processed
Core Ovens	3-04-007-07	Tons Sand Processed
Pouring/Casting	3-04-007-08	Tons Metal Processed
Casting Shakeout	3-04-007-09	Tons Metal Processed
Casting Knockout	3-04-007-10	Tons Sand Handled
Cleaning	3-04-007-11	Tons Metal Processed
Charge Handling	3-04-007-12	Tons Metal Processed
Casting Cooling	3-04-007-13	Tons Metal Processed
Casting Shakeout Machine	3-04-007-14	Tons Sand Handled
Finishing	3-04-007-15	Tons Metal Processed
Sand Grinding/Handling	3-04-007-16	Tons Metal Processed
Core Ovens	3-04-007-17	Tons Metal Processed
Core Ovens	3-04-007-18	Gallons Core Oil Used
Sand Dryer	3-04-007-20	Tons Sand Handled
Sand Silo	3-04-007-21	Tons Sand Handled
Muller	3-04-007-22	Tons Sand Handled
Conveyors/Elevators-Sand	3-04-007-23	Tons Sand Handled
Sand Screens	3-04-007-24	Tons Sand Handled

TABLE 9.7-6

(CONTINUED)

Process Description	SCC	Units (Pounds per ____)
Casting Cleaning/Tumblers	3-04-007-25	Tons Casting Cleaned
Casting Cleaning/Chippers	3-04-007-26	Tons Castings Cleaned
Shell Core Machines	3-40-007-30	Tons Core Produced
Other Core Machines	3-04-007-31	Tons Core Produced
Electric Arc Furnace: Baghouse	3-04-007-32	Tons Metal Processed
Electric Arc Furnace: Baghouse Dust Handling	3-04-007-33	Tons Metal Processed
Raw Material Unloading	3-04-007-35	Tons Raw Material Handled
Conveyors/Elevators-Raw Material	3-04-007-36	Tons Raw Material
Raw Material Silo	3-04-007-37	Tons Raw Material Stored
Scrap Centrifugation	3-04-007-39	Tons Scrap Processed
Reheat Furnace: Natural Gas	3-04-007-40	Tons Reheated
Scrap Combustion	3-04-007-41	Tons Scrap Processed
Crucible	3-04-007-42	Tons Metal Processed
Pneumatic Converter Furnace	3-04-007-43	Tons Metal Processed
Ladle	3-04-007-44	Tons Metal Processed
Alloy Feeding	3-04-007-60	Tons Handled
Billet Cutting	3-04-007-65	Tons Handled
Scrap Handling	3-04-007-68	Tons Handled
Slag Storage Pile	3-04-007-70	Tons Handled
Slag Crushing	3-04-007-75	Tons Handled
Limerock Handling	3-04-007-80	Tons Handled
Roof Monitors-Hot Metal Transfer	3-04-007-85	Tons Handled
Other Not Classified	3-04-007-99	Tons Processed

TABLE 9.7-6

(CONTINUED)

Process Description	SCC	Units (Pounds per ____)
Fugitive Emissions		
Open Piles-Scrap Metal	3-05-103-07	Tons Processed
Open Piles-Sand	3-05-103-09	Tons Processed
Open Piles-Fluxes	3-05-103-10	Tons Processed
Open Piles-General	3-05-103-99	Tons Processed
Fugitive Furnace Emissions	3-04-007-45	Tons Processed
Miscellaneous Fugitive Emissions	3-04-888-01 to -05	Tons Product

TABLE 9.7-7

**SOURCE CLASSIFICATION CODES FOR SECONDARY ZINC PROCESSING INDUSTRY
(SIC CODE 3341)**

Process Description	SCC	Units (Pounds per _____)
Process Emissions		
Retort Reduction Furnace	3-04-008-01	Tons Produced
Muffle Distillation	3-04-008-02	Tons Produced
Kettle Pot Melting Furnace	3-04-008-03	Tons Produced
Galvanizing Kettle	3-04-008-05	Tons Zinc Used
Sodium Carbonate Leaching (Calcining Kiln)	3-04-008-06	Tons Produced
Rotary Sweat Furnace	3-04-008-09	Tons Produced
Muffle Sweat Furnace	3-04-008-10	Tons Produced
Electric Resistance Sweat Furnace	3-04-008-11	Tons Produced
Kettle Sweat Furnace, Clean Metallic Scrap	3-04-008-14	Tons Produced
Reverberatory Sweat Furnace, Clean Metallic Scrap	3-04-008-18	Tons Produced
Kettle Sweat Furnace, General Metallic Scrap	3-04-008-24	Tons Produced
Reverberatory Sweat Furnace, General Metallic Scrap	3-04-008-28	Tons Produced
Kettle Sweat Furnace, Residual Scrap	3-04-008-34	Tons Produced
Reverberatory Sweat Furnace, Residual Scrap	3-04-008-38	Tons Produced
Alloying	3-04-008-40	Tons Produced
Crucible	3-04-008-41	Tons Produced
Reverberatory Furnace	3-04-008-42	Tons Produced
Electric Induction Furnace	3-04-008-43	Tons Produced
Retort and Muffle Distillation, Pouring	3-04-008-51	Tons Produced
Retort and Muffle Distillation, Casting	3-04-008-52	Tons Produced

TABLE **9.7-7**

(CONTINUED)

Process Description	SCC	Units (Pounds per ____)
Graphite Rod Distillation	3-04-008-53	Tons Produced
Retort Distillation/Oxidation	3-04-008-54	Tons of Zinc Oxide Produced
Muffle Distillation/Oxidation	3-04-008-55	Tons of Zinc Oxide Produced
Fugitive Emissions		
Crushing/Screening	3-04-008-12	Tons of Charge
Reverberatory Sweating	3-04-008-61	Tons Produced
Rotary Sweating	3-04-008-62	Tons Produced
Muffle Sweating	3-04-008-63	Tons Produced
Kettle (Pot) Sweating	3-04-008-64	Tons Produced
Electrical Resistance Sweating	3-04-008-65	Tons of Scrap Processed
Sodium Carbonate Leaching	3-04-008-66	Tons Produced
Kettle (Pot) Melting Furnace	3-04-008-67	Tons Produced
Crucible Melting Furnace	3-04-008-68	Tons Produced
Reverberatory Melting Furnace	3-04-008-69	Tons Produced
Electric Induction Melting	3-04-008-70	Tons Produced
Alloying Retort Distillation	3-04-008-71	Tons Produced
Retort and Muffle Distillation	3-04-008-72	Tons Produced
Casting	3-04-008-73	Tons Produced
Graphite Rod Distillation	3-04-008-74	Tons Produced
Retort Distillation/Oxidation	3-04-008-75	Tons Produced
Muffle Distillation/Oxidation	3-04-008-76	Tons Produced
Retort Reduction	3-04-008-77	Tons Produced

TABLE 9.7-8

AIRS CONTROL DEVICE CODES FOR SECONDARY METAL PROCESSING

Control Device	Code
Wet Scrubber - High-Efficiency	001
West Scrubber - Medium-Efficiency	002
Wet Scrubber - Low-Efficiency	003
Centrifugal Collector (Cyclone) - High-Efficiency	007
Centrifugal Collector (Cyclone) - Medium-Efficiency	008
Centrifugal Collector (Cyclone) - Low-Efficiency	009
Electrostatic Precipitator - High-Efficiency	010
Electrostatic Precipitator - Medium-Efficiency	011
Electrostatic Precipitator - Low-Efficiency	012
Fabric Filter - High-Temperature	016
Fabric Filter - Medium-Temperature	017
Fabric Filter - Low-Temperature	018
Catalytic Afterburner	019
Catalytic Afterburner with Heat Exchanger	020
Direct Flame Afterburner	021
Direct Flame Afterburner with Heat Exchanger	022
Vapor Recovery System	047
Venturi Scrubber	053
Process Enclosed	054
Impingement Plate Scrubber	055
Dust Suppression - Water Spray	061
Dust Suppression - Chemical Stabilization	062
Wet Lime Slurry Scrubbing	067

TABLE 9.7-8

(CONTINUED)

Control Device	Code
Sodium Carbonate Scrubbing	069
Sodium Alkali Scrubbing	070
Single Cyclone	075
Multiple Cyclone without Fly Ash Reinjection	076
Multiple Cyclone with Fly Ash Reinjection	077
Wet Cyclone Separator	085
Miscellaneous Control Device	099
Dust Suppression - Physical Stabilization	106

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